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ARMY ENGINEER DISTRICT ST LOUIS MO  
NATIONAL DAM SAFETY PROGRAM, GLEN LEONARD DAM (MO 30428), MISSI--ETC(U)  
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18. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.		

FORM 1473

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

LOWER MISSISSIPPI RIVER BASIN

GLEN LEONARD DAM  
JEFFERSON COUNTY, MISSOURI

MISSOURI INVENTORY NO. 30428

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

PREPARED BY: ST. LOUIS DISTRICT CORPS OF ENGINEERS  
FOR: GOVERNOR OF MISSOURI

SEPTEMBER 1978

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PHASE I REPORT  
NATIONAL DAM SAFETY PROGRAM

NAME: Glen Leonard

LOCATION: Jefferson County, Missouri

STREAM: Unnamed Tributary of Heads Creek

DATE OF INSPECTION: 5 September 1978

Glen Leonard Dam (Mo. 30428) was inspected using the "Recommended Guidelines for Safety Inspection of Dams." These guidelines were developed by the Chief of Engineers, U.S. Army, Washington D.C., with the help of Federal and State agencies, professional engineering organizations, and private engineers. The resulting guidelines are considered to represent a consensus of the engineering profession.

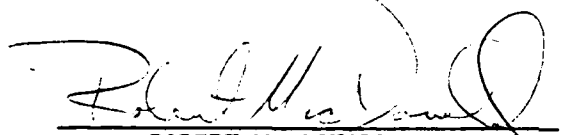
Based on the criteria in the guidelines, the dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur in the event of failure of the dam. The downstream damage zone is approximately 3 miles long. Over 10 existing homes plus more than 10 additional planned home sites are located within one mile downstream of the dam. These homes and four improved road crossings would be subjected to flooding with possible damage and/or destruction and possible loss of life if the dam should suddenly fail. The dam is in the small size classification because it is less than 40 feet high and impounds less than 1000 acre-feet of water.

For its size and hazard category, this dam is required by the guidelines to pass one-half PMF to the PMF. However, considering the high hazard potential to life (10 existing homes and 10 planned homes) and property downstream of the dam, the PMF is considered the appropriate spillway design flood. The PMF is defined as resulting from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The spillway of this dam will pass only 15 percent of the PMF without overtopping the dam. Our evaluation indicates that the spillway will not pass the 100-year flood, that is a flood having a 1 percent chance of exceedence in any given year, without the dam being overtopped. Since the spillway for Glen Leonard Dam is not capable of passing a minimum of one-half (50 percent) of the PMF without overtopping the dam which may cause failure, the spillway is considered seriously inadequate and the dam is accordingly considered an unsafe, non-emergency structure.

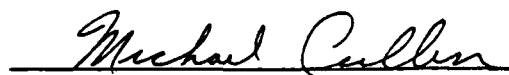
The inspection team observed heavy vegetation covering the dam and spillway. Some trees were 12 to 14 inches in diameter. All areas not covered with trees were overgrown with very heavy brush. The root systems of this vegetation are a potential seepage hazard and constitute a maintenance deficiency. Visual observations were very limited because of the heavy vegetation. Potential exists for other deficiencies such as rodent holes to be found after the trees and brush have been removed.

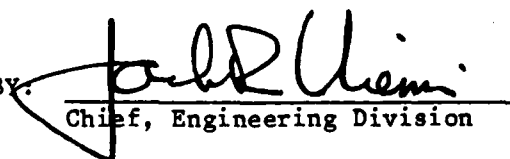
Seepage and stability analyses are not on record as recommended in the guidelines, which is considered a deficiency that should be rectified.

It is recommended that action be taken by the owner to implement the remedial measures listed herein in the near future. Any corrective works performed in relation to increasing the spillway size and/or dam height and stability, and seepage investigations of the embankment should be made in accordance with analyses and design performed by an engineer experienced in the design of dams. These conclusions were reached by the undersigned inspection team members.

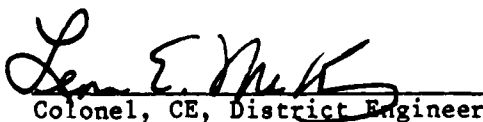
  
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Chief, Engineering Division

27 Sept 78  
Date

APPROVED BY:   
Colonel, CE, District Engineer

27 Sep 78  
Date



OVERVIEW OF GLEN LEONARD DAM AND LAKE

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM  
GLEN LEONARD DAM

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PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM  
GLEN LEONARD DAM ID NO. 30428

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of the Glen Leonard Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. The inspection was accomplished using the "Recommended Guidelines for Safety Inspection of Dams." These guidelines were developed by the Chief of Engineers, U. S. Army, Washington, D. C., with the help of several Federal and State agencies, professional engineering organizations, and private engineers. The resulting guidelines are considered to represent a consensus of the engineering profession.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) The dam is an earth structure built in a small valley in the north-east portion of the Missouri Ozark Region. Topography adjacent to the lake is rolling. Topography in the vicinity of the dam is shown on PLATE 2.

(2) The spillway is a non-regulated broad-crested weir located in the left abutment. The approach and exit channels are not well defined because of heavy vegetation growth. (See photographs 2 and 3.)

(3) Pertinent physical data are given in paragraph 1.3 below.

b. Location. The dam is located in the north-east portion of Jefferson County, Missouri, just southwest of Otto, Missouri. The lake formed by the dam is shown on the 1974 revised Belew Creek, Missouri USGS Quadrangle Sheet in the southeast quarter of Section 26, Township 42N, Range 4E (see PLATES 1 and 2).

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in Volume 1, Appendix D, Chapter 5, of the National Program of Inspection of Dams Report. Based on these criteria, this dam and impoundment is in the small size classification.

d. Hazard Classification. Criteria for determining hazard classification are presented in the same report as referenced in paragraph c above. Based on referenced criteria, this dam is in the High Hazard Classification. A high hazard dam is one which poses hazards to human life or which would cause extensive property damage should the dam suddenly fail. Over 10 existing homes plus more than 10 additional planned home sites are located within one mile downstream of this dam. These homes and four improved road crossings would be subjected to potential damage and/or destruction and loss of more than a few human lives could result if this dam should suddenly fail. A sudden failure of this dam may cause damage up to three miles downstream.

e. Ownership. This dam is owned by the Colwil Investment Company, Route 2, Highway 21, Arnold, Missouri.

f. Purpose of Dam. The dam forms a 7-acre recreation lake.

g. Design and Construction History. The dam was reportedly constructed in 1956 by Glen and Marvin Leonard. The history available is that which follows as verbally reported by Marvin Leonard. Vegetation was stripped from the foundation area of the dam and a cutoff trench was excavated to bedrock at the centerline of the dam. The bottom of the trench reportedly was 12 to 15 feet wide and the maximum depth was about 12 feet. Clay backfill was placed in the trench. The dam embankment was constructed of random clay gravel material excavated from the lake area. The spillway width was doubled to its present width and the depth was increased one foot during 1957, subsequent to a large rainfall which caused the spillway to flow. Seepage began as soon as the lake was filled. Mr. Leonard estimated the seepage which occurred in 1957 to be equivalent to an 8-inch diameter pipe flowing full, and indicated that the lake dropped to a low level in about three weeks. The seepage surfaced at a point about 300 feet downstream of the right abutment near the road, the same location where seepage still occurs (see paragraph 3.1d). An unsuccessful attempt was made to seal the lake by placing material on the bottom. A core boring was made from

the top of the dam near the old streambed. The driller concluded that the leakage was occurring through a rock strata which was located at a depth of 80 feet. Mr. Leonard indicated that since he and his brother had constructed several small dams in the area, they had not sought engineering assistance to design the dam. No construction plans or documented records are available.

h. Normal Operating Procedure. There are no spillway or outlet structures which can be manually controlled. The normal level of the pool is far below the spillway crest because of seepage which occurs at higher lake levels as described in paragraphs 1.2g.

### 1.3 PERTINENT DATA

a. Drainage Area - 246 Acres

b. Discharge at Damsite - Unknown - The spillway is the only outlet from the dam. Former owner reports that spillway discharge occurred only once (1957) at which time water was about 2 feet below the top of the dam. The spillway was subsequently enlarged as reported in paragraph 1.2g.

c. Elevation (feet above MSL)

- (1) Top of dam - 760.0  $\pm$
- (2) Spillway Crest - 756.0  $\pm$
- (3) Streambed at toe of dam - 731.0  $\pm$
- (4) Maximum tailwater - Unknown

d. Reservoir:

- (1) Length of maximum pool - approximately 2300  $\pm$  feet.
- (2) Length of recreation pool - approximately 1300  $\pm$  feet.

e. Reservoir Surface (acres):

- (1) Top of dam - 8.0 (reported by owner)  
7.4 (topographic quadrangle map)
- (2) Spillway crest - 6.5 (topographic quadrangle map)

f. Storage (Acre-feet)

- (1) Top of dam - 100 (estimated from map)
- (2) Spillway Crest - 75 (estimated from map)

g. Dam.

- (1) Type - earth embankment
- (2) Length - 560  $\pm$  feet
- (3) Height - 29  $\pm$  feet maximum
- (4) Top width - 14  $\pm$  feet
- (5) Side slopes -
  - (a) Downstream - 1V on 1.8H (Average)
  - (b) Upstream - 1V on 2.4H (Average)
- (6) Zoning - Description reported by previous owner indicated embankment was not zoned.
- (7) Impervious core - Description reported by previous owner indicated impervious core was not constructed.
- (8) Cutoff - Reported by previous owner to exist with dimensions of 12 to 15 feet wide and a 12-foot maximum depth to bedrock (see paragraph 1.2g).
- (9) Grout curtain - Description reported by previous owner indicated no grout curtain was constructed.

i. Spillway

- (1) Type - Uncontrolled (earth channel)
- (2) Width of weir - 65  $\pm$  feet
- (3) Length of weir - approximately 300 feet
- (4) Crest elevation - 756.0

j. Regulating Outlets: None

## SECTION 2 - ENGINEERING DATA

### 2.1 DESIGN

No design drawings or calculations are available for this dam. It was built by the previous owner and members of his family.

### 2.2 CONSTRUCTION

Construction was completed in 1956. No construction records are available.

### 2.3 OPERATION

No operations because spillway is ungated.

### 2.4 EVALUATION

a. Availability. The only data readily available is that which could be recalled by the present owner and the description provided by the previous owner (see paragraph 1.2g).

b. Adequacy. Data available were not adequate to make a detailed engineering analysis of the dam. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed and made a matter of record.

c. Validity. No valid engineering design data or construction data were available.

## SECTION 3 - VISUAL INSPECTION

### 3.1 FINDINGS

a. General. Glen Leonard Dam was visually inspected by a soils engineer and hydraulics engineers on 5 September 1978. Visual observations of the dam and spillway and the area downstream of the dam were very limited due to the areas being heavily overgrown with vegetation. The owner met the inspection team and discussed briefly some of the history of the construction and performance of the dam. The previous owner was contacted on 12 September 1978 and furnished additional information. Neither owner knew of any stability, or overtopping problems since the dam was first filled in 1956. Observations made by the inspection team are discussed below.

b. Dam. The dam has a narrow crest (14 + feet) and a height estimated at 29 feet (see PLATES 3 and 4). An embankment cross section is shown on PLATE 4. The slopes indicated are considered typical of the slopes on the entire embankment. The upstream and downstream slopes and spillway and exit channel are heavily covered with trees, brush and grass which would be detrimental to spillway flows. (See photographs 4, 5 and 6.) The spillway channel runs for about 300 feet downstream from the dam on a very small slope, then tapers off into the hills on the left of the old streambed.

No seeps, slides, cracks or detrimental settlement were observed on the dam embankment.

No riprap was observed anywhere on the upstream or downstream slopes of the dam or on the spillway. There was, however, no evidence of erosion to the lake shore or dam embankment.

c. Reservoir Area. No wave wash, excessive erosion, or slides were observed along the shore line.

It appears that the lake regularly fills to about 5-6 feet above the water surface elevation of the lake observed on the day of the field inspection which was approximatey 740.6. This was confirmed by the owner who stated that each spring the water surface rises about 5 or 6 feet with runoff.

d. Downstream Seepage Area. The owner stated that when the water surface rises a few feet above the elevation on the day of the inspection (740.6+), seepage surfaces at a point about 300 feet downstream of the abutment. Hydrophytic growth indicated the probable presence of water consistent with the reported fact that seepage may have occurred at other times.

### 3.2 EVALUATION

The tree growth on the dam is very extensive and poses a potential seepage problem. The seepage reported by the owner during high water also poses a potential problem as the source and path of the flow is unknown. (See paragraphs 1.2g.)



## SECTION 4 - OPERATIONAL PROCEDURES

### 4.1 PROCEDURES

There is no regulation of flow.

### 4.2 MAINTENANCE OF DAM

As shown on Photos 2 through 6, the entire dam area has not been maintained as evidenced by the heavy brush and tree growth.

### 4.3 MAINTENANCE OF OPERATING FACILITIES

None

### 4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

No warning system is known to exist.

### 4.5 EVALUATION

Maintenance and Operation of existing facilities were inadequate at the time of this inspection.

## SECTION 5 - HYDRAULIC/HYDROLOGIC

### 5.1 EVALUATION OF FEATURES

a. Design Data. No design data were made available to the inspection team. The present owner bought the property after the lake was built, and he did not have any design data. The previous owners indicated engineering assistance was not sought to design the dam.

b. Experience Data. All of the pertinent data furnished in this report are based on computations derived from either a U.S. Geological Survey 7-1/2 minute quadrangle sheet (Belew Creek, Missouri) or measurements and surveys made during the field inspection.

c. Visual Observations. It appears that the lake regularly fills to about 5-6 feet above the water surface elevation of the lake observed on the day of the field inspection which was 740.6  $\pm$ . This was later confirmed by the owner who stated that each spring the water surface rises about 5 or 6 feet with runoff. The spillway exit channel at the left of the dam is not well defined. This spillway channel runs for about 300 feet downstream from the dam on a very small slope then tapers off into the hills on the left of the old streambed. The channel and channel entrance are not well maintained, being overgrown with thick vegetation and trees.

d. Overtopping Potential. The spillway cannot pass the Probable Maximum Flood (PMF) without overtopping the dam. The 1 percent flood would also overtop the dam. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The spillway will pass approximately 15 percent of the PMF without overtopping. For the PMF and the one-half PMF, the dam would be overtopped 1.8 feet and 0.9 feet for 5.7 hours and 0.9 hours with a discharge of 4600 cfs and 2300 cfs, respectively.

## SECTION 6 - STRUCTURAL STABILITY

### 6.1 EVALUATION OF STRUCTURAL STABILITY

- a. Visual Observations. Visual observations of the dam and spillway are discussed and evaluated in Sections 3 and 5. The dam has no other appurtenant structures.
- b. Design and Construction Data. No detailed design or construction data are available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed and made a matter of record.
- c. Operating Records. No operating records are available.
- d. Post Construction Changes. A waterline was buried on the downstream side of the crest of the dam. Backfill around the pipe has settled unevenly. According to the previous owner the spillway was enlarged to its present size in 1957 as reported in paragraph 1.2g.
- e. Seismic Stability. Glen Leonard Dam is in Seismic Zone 2, for which the recommended guidelines assign a "moderate" damage probability. The relatively low height and the type of material of which the dam was constructed minimize the likelihood of failure due to earthquake shock.

## SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

### 7.1 DAM ASSESSMENT

a. Safety. The spillway cannot pass the Probable Maximum Flood without overtopping the dam. For its size and hazard category, this dam is required by the guidelines to pass from one-half PMF to the PMF. Considering the downstream hazard of 10 inhabited homes and 10 additionally planned homes, the spillway size and/or height of the dam should be increased to pass the PMF without overtopping the dam. Overtopping of the dam would be detrimental to the structural integrity of the dam. The major deficiencies observed were vegetation on the dam and spillway and the absence of an exit channel designed to adequately pass at least the PMF. Also, the backfill for the waterline crossing the dam has settled unevenly leaving ruts in the crest of the dam. Since the spillway for Glen Leonard Dam is not capable of passing a minimum of one-half (50 percent) of the PMF without overtopping the dam and causing failure, the spillway is considered seriously inadequate and the dam is accordingly considered unsafe.

b. Adequacy of Information. Due to the lack of engineering design and construction data, the conclusions in this report were based on performance history and limited visual observations. Guidelines furnished for inspection of dams require that seepage and stability analyses be on file for each dam inspected. No such data are available for this dam. This is considered a deficiency which should be corrected.

c. Urgency. It is recommended that the remedial measures listed in Section 7.2 be accomplished in the near future. The item recommended in paragraph 7.2a should be pursued on a high-priority basis.

d. Necessity for Phase II. No Phase II inspection is required.

e. Seismic Stability. Glen Leonard Dam is in Seismic Zone 2, for which the recommended guidelines assign a "moderate" damage probability. The relatively low height and the type of material of which the dam was constructed minimize the likelihood of failure due to earthquake shock.

### 7.2 REMEDIAL MEASURES

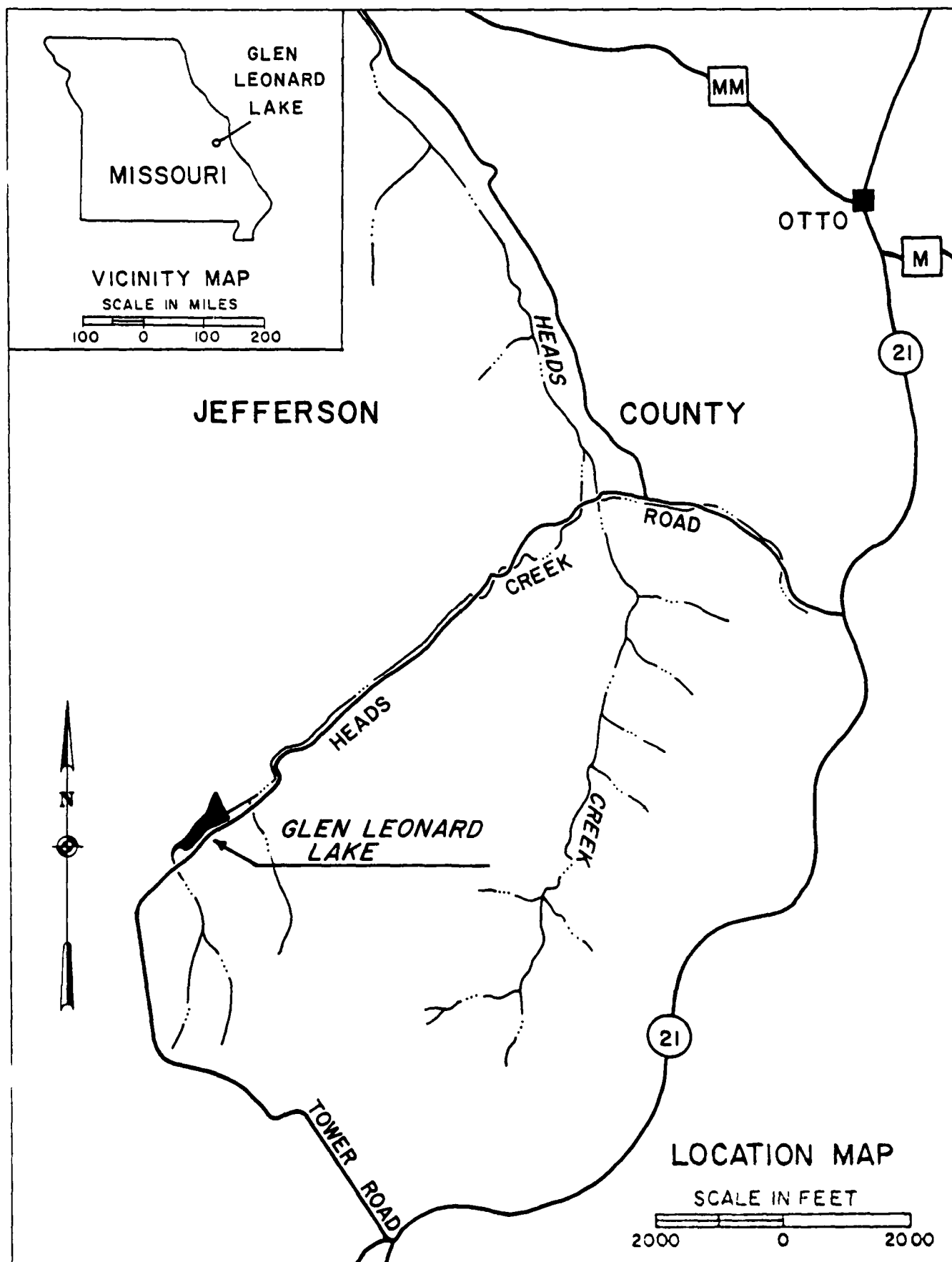
a. Alterations. Spillway size and/or dam height should be increased to pass the Probable Maximum Flood without overtopping.

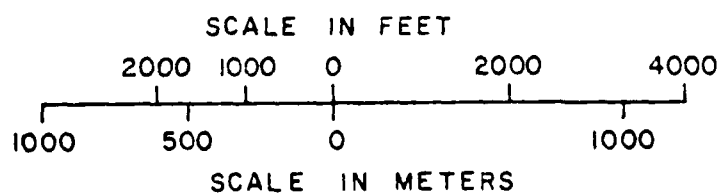
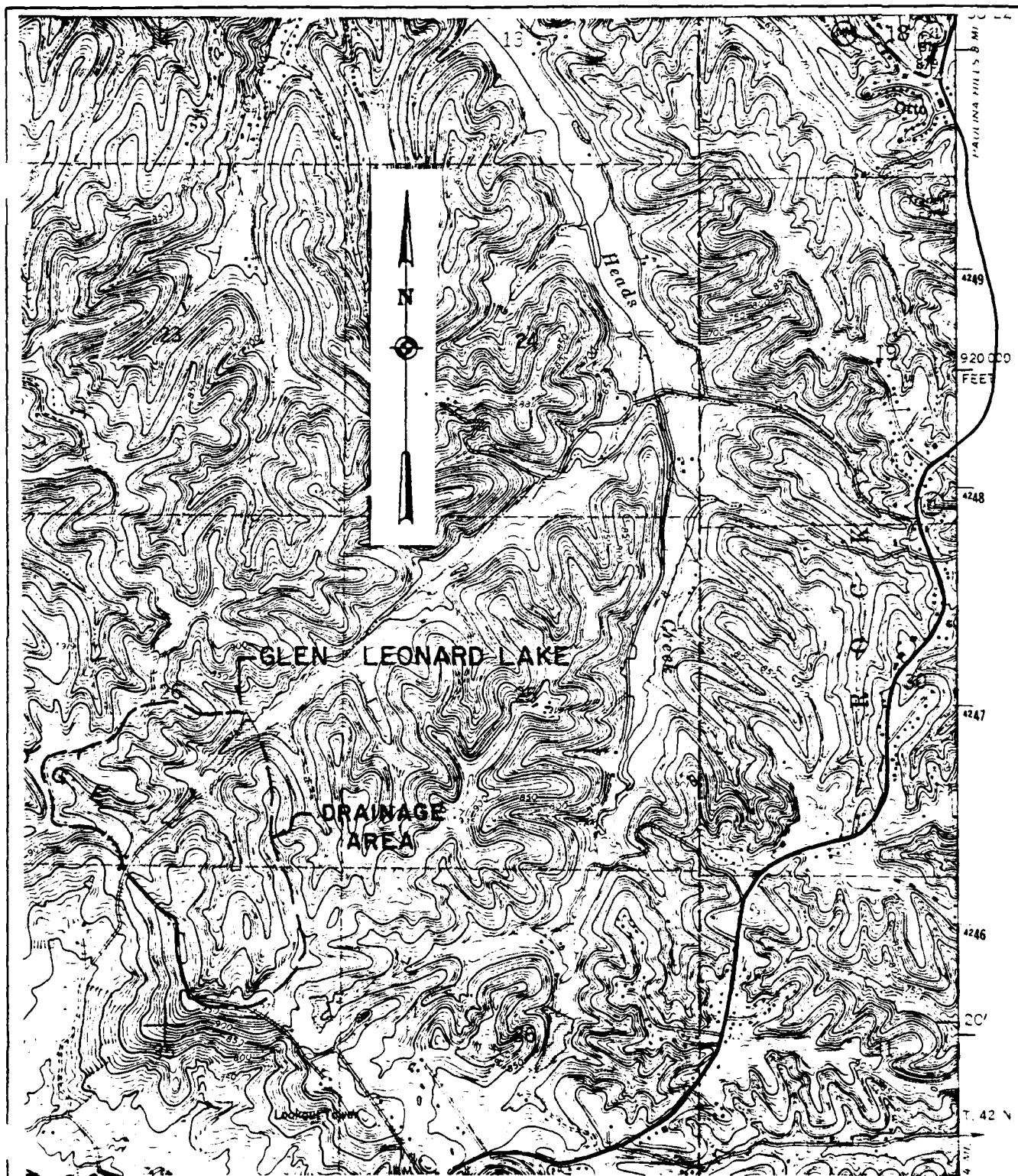
b. O&M Maintenance and Procedures. The following O&M maintenance procedures are recommended:

(1) Remove all trees and bushes growing on the embankments of the dam and in the spillway approach and exit channels. Potential exists for other deficiencies such as rodent holes to be found after the trees and brush have been removed. Establish a grass or ground cover in those areas after the trees and brush have been removed and any rodent holes found have been filled.

(2) Level the dam crest along the waterline traverse and in the small ditch traverse to the dam axis at approximately station 0+25 as shown on PLATE 3 and establish a grass cover.

c. Seepage and stability analyses should be performed by a professional engineer experienced in the design and construction of dams.





GLEN LEONARD LAKE  
VICINITY TOPOGRAPHY

PLATE 2

# GLEN LEONARD LAKE DAM PLAN

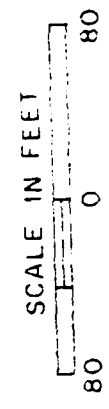
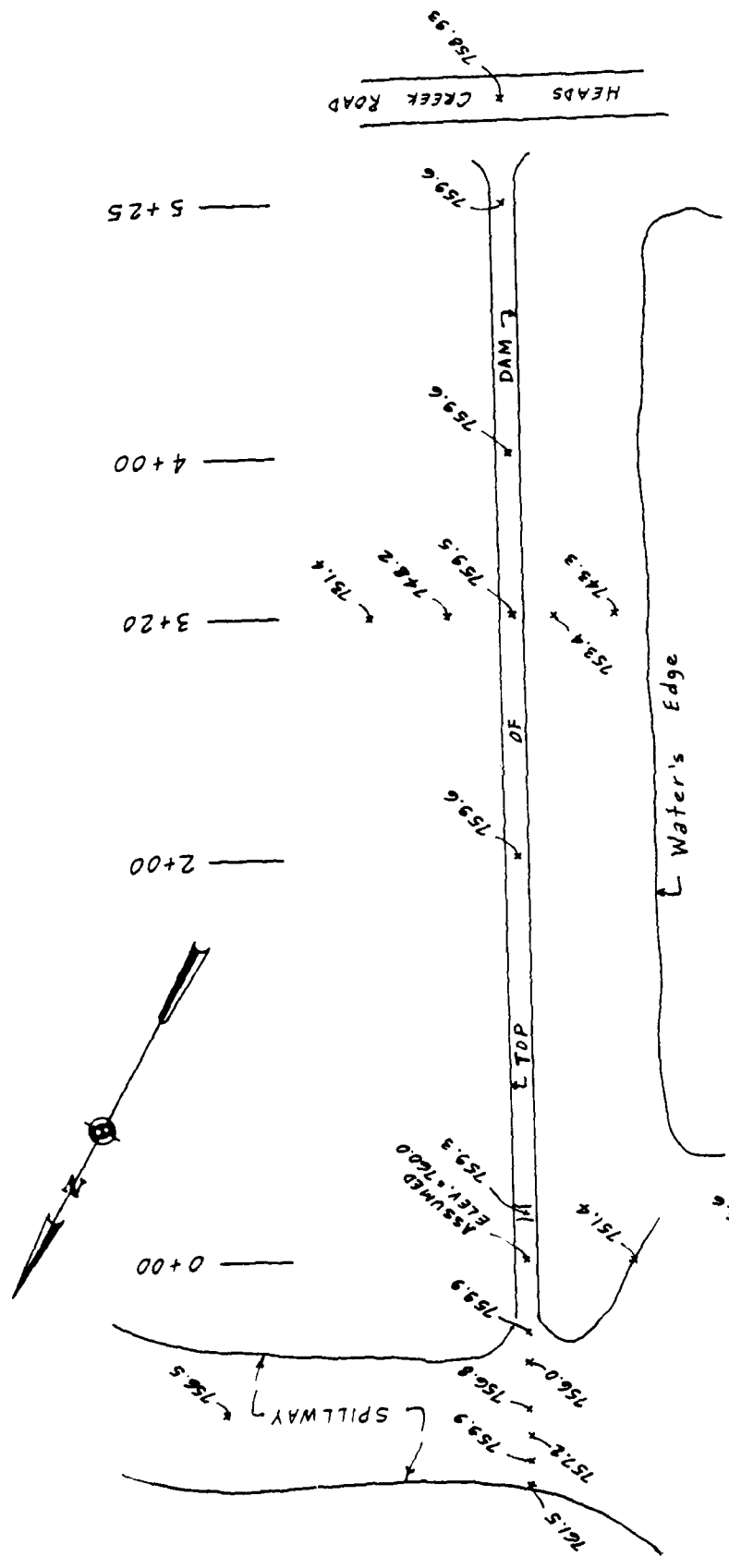


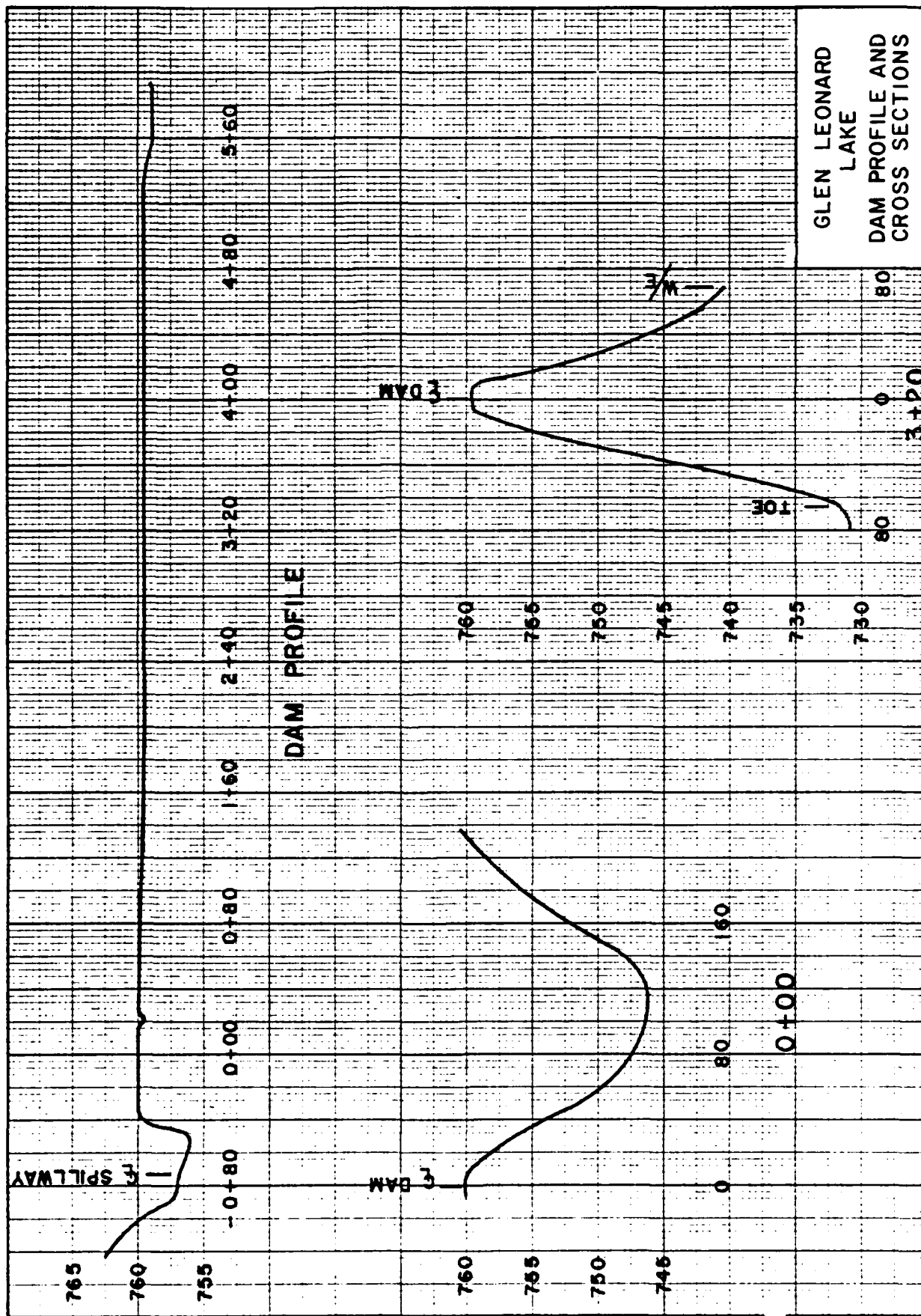
PLATE 3

LAKE

WATER SURFACE = 740.58  
9-5-78







APPENDIX  
HYDROLOGIC COMPUTATIONS

## HYDROLOGIC AND HYDRAULIC ANALYSIS METHODOLOGY

1. The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for a reservoir routing. The Probable Maximum Precipitation for those dams in the high hazard potential category is derived and determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33." Reduction factors have not been applied. A 24-hour storm duration is assumed with the 24-hour rainfall depths distributed over 6-hour periods in accordance with procedures outlined in EM 1110-2-1411 (SPF Determination). The maximum 6-hour rainfall period is then distributed to hourly increments by the same criteria. Within-the-hour distribution is based upon NOAA Technical Memorandum NWS HYDRO-35. The non-peak 6-hour rainfall periods are distributed uniformly. All distributed values are arranged in a critical sequence by the SPF criteria. The final inflow hydrograph is produced by deduction of infiltration losses appropriate to the soil, land use, and antecedent moisture conditions according to the SCS hydrograph computation procedure.

2. The reservoir routing is accomplished by using Modified Puls routing techniques wherein the flood hydrograph is routed through lake storage. Hydraulic capacities of the spillway, and crest of dam are used as outlet controls in the routing. Storage in the pool area is defined by an elevation-storage capacity curve. The spillway capacity was determined as described in paragraph 3 below. The hydraulic capacity of the top of dam was calculated using the weir equation.

3. The spillway rating curve was derived from the results of backwater computations through the spillway. Computer program HEC-2, November 1976, prepared by the Hydrologic Engineering Center, U. S. Army Corps of Engineers, Davis, California, was used to compute the water surface elevations for a range of flows through the spillway. The elevation-discharge values at the spillway entrance were used for the spillway rating curve. PLATES A-8 and A-9 show the HEC-2 input and summary printout.

4. Dam overtopping analysis has been conducted by hydrologic methods for this dam and lake. This computation determines the percentage of the PMF hydrograph that the reservoir can contain without the dam being overtopped. An output summary in the hydrologic appendix displays this information as well as other characteristics of the simulated dam overtopping.

5. The above overtopping analysis has been accomplished for this report using the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U. S. Army Corps of Engineers, Davis, California. The numeric parameters estimated for this site are listed on PLATE A1. Definitions of these variables are contained in the "User's Manual" for the computer program.

PROJECT	GLEN LEONARD DAM INSPECTION	Page 1 of 1	COMPUTED BY	DATE
SUBJECT	HID 24000 AND HID 24000 FILLING-EDS		CHECKED BY	DATE

DRAINAGE AREA = 246 ACRES = 3.34 SQ. MI.

ELEV. TOP OF DAM = 759.65 FT MSL

SPILLWAY CREST ELEV. = 756.05 FT. MSL

DAM WIDTH = 500 FT

ANTECEDENT MOISTURE CONDITION II

SCS CURVE NO 37

$T_c = .255$  HRS (USING KIRPICH EQUATION)

SPILLWAY RATING CURVE

LAKE AREA-ELEV CURVE

ELEVATION (MSL)	DISCHARGE (CFS)	AREA (ACRS)	ELEV (MSL)
757.26	10	3.0	740
758.43	100		
759.49	400	5.2	750
759.99	1000		
765.77	2000	7.4	760
769.10	4000		
781.59	6000		

WEIR COEFFICIENT AT DAM

$C = 2.5$

PLATE 41

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FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 12 SEP 78
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1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
A1 GLEN LEONARD LAKE - MULTI-RATIO OF PMF FLOOD ANALYSIS
A2 FOR THE NATIONAL DAM INSPECTION PROGRAM. INVENTORY NUMBER 30428.
A3 BY RICHARD LEIPOLD - ST. LOUIS DISTRICT - SEPT 78
B 288 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
B1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
J1 0.10 0.15 0.20 0.25 0.30 0.40 0.50 1.00 0 -5 0
K1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
M1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
P1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
T1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
U1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
X1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
K1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
Y1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
V1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
V1787.25 758.43 759.48 759.99 765.77 769.10 781.50 -756.0 -1
V5 100 400 1000 2000 4000 8000 16000 32000 64000 128000 256000 512000 1024000 2048000 4096000 8192000 16384000 32768000 65536000 131072000 262144000 524288000 1048576000 2097152000 4194304000 8388608000 16777216000 33554432000 67108864000 134217728000 268435456000 536870912000 1073741824000 2147483648000 4294967296000 8589934592000 17179869184000 34359738368000 68719476736000 137438953472000 274877906944000 549755813888000 1099511627776000 2199023255552000 4398046511104000 8796093022208000 17592186044416000 35184372088832000 70368744177664000 140737488355328000 281474976710656000 562949953421312000 1125899906842624000 2251799813685248000 4503599627370496000 9007199254740992000 18014398509481984000 36028797018963968000 72057594037927936000 144115188075855872000 288230376151711744000 576460752303423488000 1152921504606846976000 2305843009213693952000 4611686018427387904000 9223372036854775808000 18446744073709551616000 36893488147419103232000 73786976294838206464000 147573952589676412928000 295147905179352825856000 590295810358705651712000 1180591620717411303424000 2361183241434822606848000 4722366482869645213696000 9444732965739290427392000 18889465931478580854784000 37778931862957161709568000 75557863725914323419136000 151115727451828646838272000 302231454903657293676544000 604462909807314587353088000 1208925819614629174706176000 2417851639229258349412352000 4835703278458516698824704000 9671406556917033397649408000 19342813113834066795298816000 38685626227668133590597632000 77371252455336267181195264000 154742504910672534362390528000 309485009821345068724781056000 618970019642690137449562112000 1237940039285380274899124224000 2475880078570760549798248448000 4951760157141521099596496896000 9903520314283042199192993792000 19807040628566084398385987584000 39614081257132168796771975168000 79228162514264337593543950336000 158456325028528675187087900672000 316912650057057350374175801344000 633825300114114700748351602688000 1267650600228229401496703205376000 2535301200456458802993406410752000 5070602400912917605986812821504000 10141204801825835211973625643008000 20282409603651670423947251286016000 40564819207303340847894502572032000 81129638414606681695789005144064000 162259276829213363391578010288128000 324518553658426726783156020576256000 649037107316853453566312041152512000 1298074214633706907132624082305024000 2596148429267413814265248164610048000 5192296858534827628530496329220096000 10384593717069655257060992658440192000 20769187434139310514121985316880384000 41538374868278621028243970633760768000 83076749736557242056487941267521536000 166153499473114484112975882535043072000 332306998946228968225951765070086144000 664613997892457936451903530140172288000 1329227995784915872903807060280344576000 2658455991569831745807614120560689152000 5316911983139663491615228241121378304000 10633823966279326983230456482242756608000 21267647932558653966460912964485513216000 42535295865117307932921825928971026432000 85070591730234615865843651857942052864000 170141183460469231731687303715884105728000 340282366920938463463374607431768211456000 680564733841876926926749214863536422912000 1361129467683753853853498429727072845824000 2722258935367507707706996859454145691648000 5444517870735015415413993718908291383296000 10889035741470030830827987437816582766592000 21778071482940061661655974875633165533184000 43556142965880123323311949751266331066368000 87112285931760246646623899502532662132736000 174224571863520493293247799005065324265472000 348449143727040986586495598010130648530944000 696898287454081973172991196020261297061888000 1393796574908163946345982392040522594123776000 2787593149816327892691964784081045188247552000 5575186299632655785383929568162090376495104000 11150372599265311570767859136324180752990208000 22300745198530623141535718272648361505980416000 44601490397061246283071436545296723011960832000 89202980794122492566142873090593446023921664000 178405961588244985132285746181186892047843328000 356811923176489970264571492362373784095686656000 713623846352979940529142984724747568191373312000 1427247692705959881058285969449495136382746624000 2854495385411919762116571938898990272765493248000 5708990770823839524233143877797980545530986496000 11417981541647679048466287755595961091061972992000 22835963083295358096932575511191922182123945984000 45671926166590716193865151022383844364247891968000 91343852333181432387730302044767688728495783936000 182687704666362864775460604089535377456991567872000 365375409332725729550921208179070754913983135744000 730750818665451459101842416358141509827966271488000 1461501637330902918203684832716283019655932542976000 2923003274661805836407369665432566039311865085952000 5846006549323611672814739330865132078623730171904000 11692013098647223345629478661730264157247460343808000 23384026197294446691258957323460528314494920687616000 46768052394588893382517914646921056628989841375232000 93536104789177786765035829293842113257979682750464000 187072209578355573530071658587684226515959365500928000 374144419156711147060143317175368453031918731001856000 748288838313422294120286634350736906063837462003712000 1496577676626844588240573268701473812127674924007424000 2993155353253689176481146537402947624255349848014848000 5986310706507378352962293074805895248510699696029696000 11972621413014756705924586149611790497021399392059392000 23945242826029513411849172299223580994042798784118784000 47890485652059026823698344598447161988085597568237568000 95780971304118053647396689196894323976171195136475136000 191561942608236107294793378393788647952342390272950272000 383123885216472214589586756787577295904684780545900544000 766247770432944429179173513575154591809369561091801088000 1532495540865888858358347027150309183618739122183602176000 3064991081731777716716694054300618367237478244367204352000 6129982163463555433433388108601236734474956488734408704000 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803469022129495137770981046170581301261101496891396417138688000 1606938044258990275541962092341162602522202993782792834277376000 3213876088517980551083924184682325205044405987565585668554752000 6427752177035961102167848369364650410088811975131171337109504000 12855504354071922204335696738729300820177623950262342674219008000 25711008708143844408671393477458601640355247900524685348438016000 51422017416287688817342786954917203280710495801049370696876032000 102844034832575377634685573909834406561420991602098741393752064000 205688069665150755269371147819668813122841983204197482787504128000 411376139330301510538742295639337626245683966408394965575008256000 822752278660603021077484591278675252491367932816789931150016512000 1645504557321206042154969182557350504982735865633579862300033024000 3291009114642412084309938365114701009965471731267159724600066048000 6582018229284824168619876730229402019930943462534319449200132096000 13164036458569648337239753460458804039861886925068638898400264192000 26328072917139296674479506920917608079723773850137277796800528384000 52656145834278593348959013841835216159447547700274555593601056768000 105312291668557186697918027683670432318895095400549111187202113536000 210624583337114373395836055367340864637790190801098222374404227072000 421249166674228746791672110734681729275580381602196444748808454144000 842498333348457493583344221469363458551160763204392889496169088288000 1684996666696914987166688442938726917102321526408785778992338176576000 3369993333393829974333376885877453834204643052817571557946676353152000 6739986666787659948666753771754907668409286105635143115893352706304000 13479973333575319897333507543509815336818572211270286231786705412608000 26959946667150639794667015087019630673637144422540572463573410825216000 53919893334301279589334030174039261347274288845081144927146821650432000 107839786668602559178668060348078522694548577690162289854293643300864000 215679573337205118357336120696157045389097155380324579708587286601728000 431359146674410236714672241392314090778194310760649159417174573203456000 862718293348820473429344482784628181556388621521298318834349146406912000 1725436586697640946858688965569256363112777243042596637668698292813824000 3450873173395281893717377931138512726225554486085193275337396585627648000 6901746346790563787434755862277025452451108972170386550674793171255296000 13803492693581127574869511724554050904902217944340773101349586342510592000 27606985387162255149739023449108101809804435888681546202699172685021184000 55213970774324510299478046898216203619608871777363092405398345370042368000 110427941548649020598956093796432407239217743554726184810796690740084736000 220855883097298041197912187592864814478435487109452369621593381480169472000 441711766194596082395824375185729628956870974218904739243186762960338944000 883423532389192164791648750371459257913741948437809478486373525920677888000 1766847064778384329583297500742918515827483896875618956972747051841355776000 3533694129556768659166595001485837031654967793751237913945494103682711552000 7067388259113537318333190002971674063309935587502475827890988207365423104000 14134776518227074636666380005943348126619871175004951655781976414730846208000 28269553036454149273332760011886696253239742350009903311539952829461692416000 56539106072908298546665520023773392506479484700019806623077999858923384832000 113078212145816597093331040047546785012958969400039613246155997177846766864000 226156424291633194186662080095093570025917938800079226492311994355693533728000 452312848583266388373324160190187140051835877600158452984623988711387067456000 904625697166532776746648320380374280103671755200316905969247977422774134912000 1809251394333065553493296640760748560207343510400633811938495954845548269824000 3618502788666131106986593281521497120414687020801267623876991909691096539648000 7237005577332262213973186563042994240829374041602535247753983819382193079296000 14474011154664524427946373126085988481658748083205070495507967638764386158592000 28948022309329048855892746252171976963317496166410140991015935277528772317184000 57896044618658097711785492504343953926634992332820281982031870555057544634368000 115792089237316195423570985008687907853269984665640563964063741110115089268736000 231584178474632390847141970017375815706539969331281127928127482220230178537472000 463168356949264781694283940034751631413079938662562255856254964440460357074944000 926336713898529563388567880069503262826159877325124511712509928880920714149888000 1852673427797059126777135760139006525652319754650249023425119457761841428299776000 3705346855594118253554271520278013051304639509300498046850238915523682856599552000 7410
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DATE: 78/09/15  
TIME: 08:41:38

GLEN LEONARD LAKE - MULTI-RATIO OF PHF FLOOD ANALYSIS  
FOR THE NATIONAL DAM INSPECTION PROGRAM. INVENTORY NUMBER 30428.  
BY RICHARD LEIFIELD - ST. LOUIS DISTRICT - SEPT 78

NO	NMR	MNIN	IDAY	JOB SPECIFICATION	IMR	IRIN	METRIC	IPLT	IPRT	INSTAN
008	0	5			0	0	0	0	-5	0
			JOPER		NUT	LROPT	TRACE			
			5		0		0			

[illegible]

## SUB-AREA RUNOFF COMPUTATION

## INFLOW HYDROGRAPH COMPUTATION

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INVDG 1 IUNQ 2 TAREA .38 SNAP 0.00 TRSDA .38
HYDROGRAPH DATA RATIO 0.00 ISNOU 0 ISAME 1 LOCAL 0
ISTAQ 1 ICOMP 0 IECON 0 ITAPE 0 JPLY 0 JPRT 3 JMADE 1 IMAUO 0

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SPFE	PMS	PRECIP DATA				R48	R72	R96
8.00	26.00	R6	R12	R24	R48	R72	R96	
		102.00	120.00	130.00	0.00	0.00	0.00	

LOSS DATA										
LRQPT	STKR	DLTKR	RTIOL	ERAM	STAKS	RTIOK	STATL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-07.00	0.00	.00

CURVE NO = -07.00 WETNESS = -1.00 EFFECT CN = 07.00

UNIT HYDROGRAPH DATA  
TC= 0.00 LAG= .15

STATO- 0.00 RECEPTION DATA RTIOR- 3.00  
QRCN- -.10

TIME INCREMENT TOO LARGE--(MHO IS OT LAQ/2)

UNIT HYDROGRAPH	!! END OF PERIOD ORDINATES, TC.	0.00 HOURS, LAG-	.15 VOL- 1.00
341.	897.	108.	
	238.	134.	27.
	3.	260.	13.
		53.	7.

NO. DA	HR. MM	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD PLOU COMP 0	NO. DA	HR. MM	PERIOD	RAIN	EXCS	LOSS	COMP 0
1	06	145	21	00	.01	0	1	06	145	21	00	.01	285
1	10	146	21	00	.01	1	1	10	146	21	00	.01	358
1	15	147	21	00	.01	1	1	15	147	21	00	.01	478
1	20	148	21	00	.01	1	1	20	148	21	00	.01	541
1	25	149	21	00	.01	1	1	25	149	21	00	.01	574
1	30	150	21	00	.01	1	1	30	150	21	00	.01	591
1	35	151	21	00	.01	1	1	35	151	21	00	.01	600
1	40	152	21	00	.01	1	1	40	152	21	00	.01	606
1	45	153	21	00	.01	1	1	45	153	21	00	.01	611
1	50	154	21	00	.01	1	1	50	154	21	00	.01	618
1	55	155	21	00	.01	1	1	55	155	21	00	.01	628
1	00	156	21	00	.01	1	1	00	156	21	00	.01	667
1	05	157	26	25	.01	1	1	05	157	26	25	.01	703
1	10	158	26	25	.01	1	1	10	158	26	25	.01	722
1	15	159	26	25	.01	1	1	15	159	26	25	.01	737
1	20	160	26	25	.01	1	1	20	160	26	25	.01	740
1	25	161	26	25	.01	1	1	25	161	26	25	.01	742
1	30	162	26	25	.00	1	1	30	162	26	25	.00	743
1	35	163	26	25	.00	1	1	35	163	26	25	.00	744
1	40	164	26	25	.00	1	1	40	164	26	25	.00	745
1	45	165	26	25	.00	1	1	45	165	26	25	.00	767
1	50	166	26	25	.00	1	1	50	166	26	25	.00	826
1	55	167	32	31	.00	1	1	55	167	32	31	.00	879
1	00	168	32	31	.00	1	1	00	168	32	31	.00	907
1	05	169	32	31	.00	1	1	05	169	32	31	.00	922
1	10	170	32	31	.00	1	1	10	170	32	31	.00	929
1	15	171	32	31	.00	1	1	15	171	32	31	.00	933
1	20	172	32	31	.00	1	1	20	172	32	31	.00	936
1	25	173	32	31	.00	1	1	25	173	32	31	.00	937
1	30	174	32	31	.00	1	1	30	174	32	31	.00	938
1	35	175	32	31	.00	1	1	35	175	32	31	.00	946
1	40	176	32	31	.00	1	1	40	176	32	31	.00	948
1	45	177	32	31	.00	1	1	45	177	32	31	.00	952
1	50	178	32	31	.00	1	1	50	178	32	31	.00	955
1	55	179	32	31	.00	1	1	55	179	32	31	.00	957
1	00	180	32	31	.00	1	1	00	180	32	31	.00	958
1	05	181	32	31	.00	1	1	05	181	32	31	.00	959
1	10	182	32	31	.00	1	1	10	182	32	31	.00	960
1	15	183	32	31	.00	1	1	15	183	32	31	.00	961
1	20	184	32	31	.00	1	1	20	184	32	31	.00	962
1	25	185	32	31	.00	1	1	25	185	32	31	.00	963
1	30	186	32	31	.00	1	1	30	186	32	31	.00	964
1	35	187	32	31	.00	1	1	35	187	32	31	.00	965
1	40	188	32	31	.00	1	1	40	188	32	31	.00	966
1	45	189	32	31	.00	1	1	45	189	32	31	.00	967
1	50	190	32	31	.00	1	1	50	190	32	31	.00	968
1	55	191	32	31	.00	1	1	55	191	32	31	.00	969
1	00	192	32	31	.00	1	1	00	192	32	31	.00	970
1	05	193	32	31	.00	1	1	05	193	32	31	.00	971
1	10	194	32	31	.00	1	1	10	194	32	31	.00	972
1	15	195	32	31	.00	1	1	15	195	32	31	.00	973
1	20	196	32	31	.00	1	1	20	196	32	31	.00	974
1	25	197	32	31	.00	1	1	25	197	32	31	.00	975
1	30	198	32	31	.00	1	1	30	198	32	31	.00	976
1	35	199	32	31	.00	1	1	35	199	32	31	.00	977
1	40	200	32	31	.00	1	1	40	200	32	31	.00	978
1	45	201	32	31	.00	1	1	45	201	32	31	.00	979
1	50	202	32	31	.00	1	1	50	202	32	31	.00	980
1	55	203	32	31	.00	1	1	55	203	32	31	.00	981
1	00	204	32	31	.00	1	1	00	204	32	31	.00	982
1	05	205	32	31	.00	1	1	05	205	32	31	.00	983
1	10	206	32	31	.00	1	1	10	206	32	31	.00	984
1	15	207	32	31	.00	1	1	15	207	32	31	.00	985
1	20	208	32	31	.00	1	1	20	208	32	31	.00	986
1	25	209	32	31	.00	1	1	25	209	32	31	.00	987
1	30	210	32	31	.00	1	1	30	210	32	31	.00	988
1	35	211	32	31	.00	1	1	35	211	32	31	.00	989
1	40	212	32	31	.00	1	1	40	212	32	31	.00	990
1	45	213	32	31	.00	1	1	45	213	32	31	.00	991
1	50	214	32	31	.00	1	1	50	214	32	31	.00	992
1	55	215	32	31	.00	1	1	55	215	32	31	.00	993
1	00	216	32	31	.00	1	1	00	216	32	31	.00	994
1	05	217	32	31	.00	1	1	05	217	32	31	.00	995
1	10	218	32	31	.00	1	1	10	218	32	31	.00	996
1	15	219	32	31	.00	1	1	15	219	32	31	.00	997
1	20	220	32	31	.00	1	1	20	220	32	31	.00	998
1	25	221	32	31	.00	1	1	25	221	32	31	.00	999
1	30	222	32	31	.00	1	1	30	222	32	31	.00	1000

PLATE A-4







# SUMMARY OF DAM SAFETY ANALYSIS

	ELEVATION STORAGE OUTFLOW	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM					
		759.80	759.80	759.80					
		75.	75.	100.					
		10.	10.	532.					
	MAXIMUM RESERVOIR U.S. ELEV	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS			
.10	759.86	96.	279.	0.00	15.82	0.00			
.15	759.81	100.	540.	.02	15.83	0.00			
.20	759.79	102.	866.	.25	15.76	0.00			
.25	759.91	103.	1152.	.42	15.75	0.00			
.30	760.01	104.	1376.	.58	15.75	0.00			
.40	760.87	105.	1818.	.75	15.75	0.00			
.50	760.80	107.	2283.	.92	15.75	0.00			
1.00	761.40	114.	4835.	5.67	15.75	0.00			

D

IT IS OLEN LEONARD SPILLWAY

71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	5
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SUMMARY PRINTOUT

SECHO	CUBEL	Q	KENCH	DIPUSK	AREA	UCH
1.000	757.06	10.00	157.78	0.00	2.54	2.75
1.000	757.06	100.00	129.58	0.00	23.30	2.89
1.000	757.06	400.00	96.00	0.00	82.00	2.89
1.000	757.06	1000.00	51.58	0.00	121.32	2.89
1.000	757.06	2000.00	38.61	0.00	166.97	2.89
1.000	757.06	4000.00	38.43	0.00	162.74	2.89
1.000	757.06	8000.00	38.43	0.00	165.13	2.89
1.000	757.06	10000.00	38.41	0.00	166.37	2.89
2.000	757.06	10.00	118.34	.99	27.14	.37
2.000	757.06	100.00	73.80	1.40	80.18	1.25
2.000	757.06	400.00	39.78	1.55	136.69	2.82
2.000	757.06	1000.00	39.05	1.99	170.50	2.82
2.000	757.06	2000.00	33.29	4.64	232.28	2.82
2.000	757.06	4000.00	28.30	8.20	294.72	2.82
2.000	757.06	8000.00	-9.58	21.51	351.59	2.82
2.000	820.55	10000.00	-44.35	61.42	709.42	2.82
3.000	757.06	10.00	109.57	.21	27.97	.36
3.000	757.06	100.00	63.19	.26	83.55	1.20
3.000	757.06	400.00	39.39	.31	142.30	2.81
3.000	757.06	1000.00	39.87	.40	181.11	2.81
3.000	757.06	2000.00	33.13	.48	232.77	2.81
3.000	757.06	4000.00	28.47	.58	295.32	2.81
3.000	757.06	8000.00	-9.57	.61	351.59	2.81
3.000	820.55	10000.00	-44.35	.61	709.42	2.81
4.000	757.06	10.00	38.65	.00	128.58	.00
4.000	757.06	100.00	37.39	.01	1312.59	.00
4.000	757.06	400.00	36.26	.03	1385.44	.00
4.000	757.06	1000.00	36.04	.09	1419.68	.00
4.000	757.06	2000.00	35.53	1.73	2478.65	.00
4.000	757.06	4000.00	35.06	1.65	2661.72	.00
4.000	757.06	8000.00	34.59	1.27	2846.03	.00
4.000	820.55	10000.00	-29.52	1.12	1240.03	.00

ED

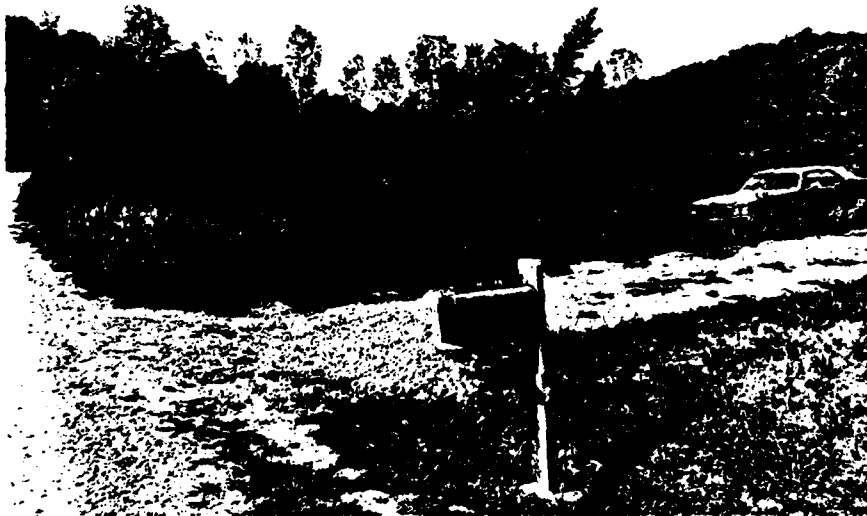


PHOTO 1 SEEPAGE AREA DOWNSTREAM OF  
DAM (Seepage Exits in Group of  
Willows at Left Foreground  
When Lake Level is Higher)



PHOTO 2 SPILLWAY APPROACH  
(Looking Toward Spillway From  
Near Water's Edge. Spillway  
is at Left Abutment - Upper  
Right of Photo).



PHOTO 3 SPILLWAY EXIT  
(Looking Downstream from Near  
Center Line of Dam)



PHOTO 4 UPSTREAM SLOPE OF DAM



PHOTO 5 TOP OF DAM  
(Looking From Left Abutment  
Toward Right Abutment)



PHOTO 6 DOWNSTREAM FACE OF DAM  
(Slope of Embankment Shown  
in Area Indicated)



DATE  
FILMED  
-8